REVISIONS

APPROVALS

AUTHORIZED SIGNATURES	REPRESENTING	DATE
[signature]	NAA/S&ID	9-1-65
D. G. Hoag by W. Stameris	MIT	6 Oct. 65

INTERFACE CONTROL DOCUMENT

DR BY A. Silagyi

CHK BY

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NORTH AMERICAN AVIATION, INC.
SPACE and INFORMATION SYSTEMS DIVISION
12214 LAKEWOOD BLVD., DOWNEY, CALIFORNIA

COMMAND MODULE GUIDANCE COMPUTER
ELECTRICAL INTERFACES BLOCK II
NAA-MIT

CODE IDENT NO. 03953 | SIZE A | MH01-01380-216

SHEET 1 OF -1

SYM	DESCRIPTION	REQD	REP	DATE	APPROVED

INTERFACE CONTROL DOCUMENT

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CODE IDENT NO. 03953 | SIZE A | MH01-01380-216

SHEET 2

REVISIONS

MODEL	PART NO.	DESCRIPTION	APPLICABLE SPEC

EFFECTIVITY AND SPECIFICATIONS

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SHEET 3

REVISIONS

Note: Unless Otherwise Specified

1. Massachusetts Institute of Technology
   Instrumentation Laboratory
   Cambridge, Massachusetts

2. North American Aviation, Inc.
   Space and Information Systems Division
   Downey, California

3. Design Data Required

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SHEET 4

REVISIONS

[illegible]

[illegible]

1.0 [illegible]

2.0 [illegible] Form and Noise Measurement [illegible]

3.0 Definition of Symbols

4.0 Reaction Control Jet Driver Signals

5.0 Control Mode and Status Signals

6.0 Attitude Signals from CGC/IMAG

7.0 Main Engine Signals

8.0 Rotational and Translational Controller Signals

9.0 Master Clock and Telemetry

10.0 CGC/DSKY Illumination

11.0 Computer to Computer Displays

12.0 Computer to S/C Displays

[illegible].0 Computer to S/C Power

REVISIONS

1.0 [illegible]

[illegible]

[illegible]

[illegible] Switch closure; [illegible] switch closure receiver.
W, WR = W: Just a wire connection; WR: receiver for "W".
R = R: DC power source.

The numbers following any particular designation (SR, XR, CR, XR2, etc.) together with the section numbers uniquely designates a particular CMC output circuit or input circuit.

1.1 Grounding Symbology

The following drawing symbology shall be used throughout this ICD:

a) AC Grounds

1. AC Power

2. AC Signal

b) DC Ground

1. DC Power

2. DC Signal Ground

c) Isolated Circuit Ground

d) Structure Ground

e) Vehicle Ground Point

REVISIONS

2.0 Waveform and Noise Measurement Techniques

1. Pulse Measurements

a. Measurements to be made at points indicated in appropriate sections of this ICD.

b. Measurements to be made with Tektronix 540 series, type 1A1 differential preamp, 10/1 attenuator probes; or equivalent. Scope to be grounded at [illegible] only, if at all.

2. Noise Measurements

a. Measurements to be made with Tektronix 540 series, type CA preamp, and P6016 current probe and type 131 amplifier; or equivalent.

b. The current to voltage conversion factor will be the load pulse impedance (200 ohms; XR, Y) or DC impedance (20K ohms; CR, D) where applicable.

3. AC Measurements

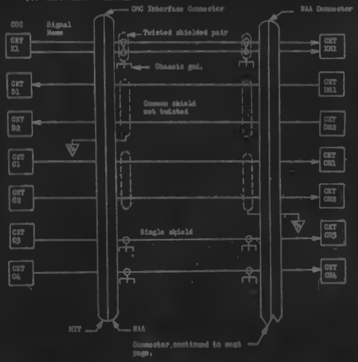
a. Hewlett-Packard 400D or equivalent.

4. DC Measurements

a. Scope or equivalent.

REVISIONS

3.0 DEFINITION OF SYMBOLS



REVISIONS

4.0 CMC to SCS Drivers

This section describes the interface between the [illegible] Computer and the SCS Reaction Control [illegible]. The [illegible] computer will provide output-discrete [illegible] to command reaction jet firing. There will be a [illegible] of [illegible] output lines provided, each line carrying the ignition command for one of the 16 S/M reaction jets or one of the 12 C/M reaction jets with the remaining four lines having no function when the SM is detached. The presence of high voltage on a line as referenced to spacecraft ground will indicate a jet OFF discrete.

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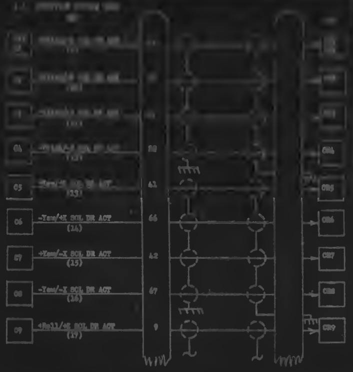
REVISIONS

4.1 [illegible]



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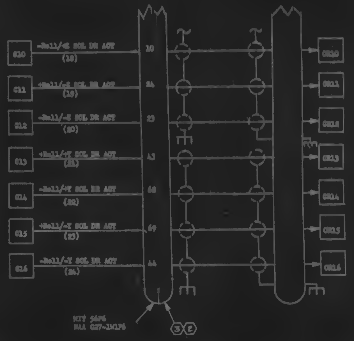
REVISIONS

4.1 Interface Wiring Data (Continued)



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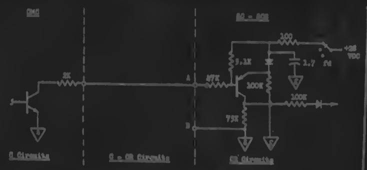
REVISIONS

4.2 Circuit and Signal Characteristics



All Measurements Made from A to B, B Ref.

Amplitude: "ON" 5 VDC ± 5 VDC
"OFF" 28 VDC ± 5 VDC

Current: "ON" 5 MA Max

Source Impedance: "ON" 2K Max to CMC Gnd, 0-5MA Range
"OFF" 0.5 Meg Ohms, 0-40 Volt Range

Source Rise Time: Less than 1 μ sec.

Noise Rejection: "ON" +20V Noise pulse, max width 0.5 millisec, maximum rep rate 10 pps
"OFF" -20V Noise pulse, max width 1 millisec, maximum rep rate 10 pps

Circuits: C1-C16 Shown Above
CR1-CR16 Shown Above

NOTE: SCHEMATICS SHOWN FOR REFERENCE ONLY

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REVISIONS

[illegible]

5.1 [illegible]

5.1.1 [illegible] ([illegible] LEM/CSM [illegible])

The LEM Attached signal will be a switch [illegible] the [illegible] Module Main Display Panel. This switch closure [illegible] upon completion of LEM transposition and docking.

5.1.2 SPS Ready (△ V Thrust, Normal - Off - Direct On)

The SPS Ready signal will be provided by a switch closure on the Command Module Main Display Panel. This switch closure will be pilot initiated and will indicate procedurally the completion of the pre Delta V checkout procedure. The SPS engine cannot be fired unless this discrete is present.

5.1.3 Attitude Hold (SC Control, CMC, Auto - Hold - Free)

The Attitude Hold signal will be a switch closure on the Command Module Main Display Panel. This switch will be pilot initiated at such time, during primary control, as it is desired to hold the present attitude of the spacecraft.

5.1.4 Free Drift (SC Control, CMC, Auto - Hold - Free)

The Free Drift signal will be a switch closure on the Command Module Main Display Panel. This switch will be pilot initiated at such time, during primary control, as it is desired to inhibit automatic control and permit manual control of the spacecraft through the GMC (hand controllers, minimum impulse).

5.1.5 Accept Uplink (UPTLM, Accept - Block)

The Accept Uplink signal will be a switch closure on the Command Module Main Display Panel. This switch will be pilot initiated at such time as it is desired to receive information via the update link. A similar switch shall be provided in the LEB. Both switches must be in accept position to receive uplink data.

5.1.6 C/M - S/M Separate

The Service Module Separation signal will be a parallel contact closure within the SM/CM Reaction Jet Control Transfer unit. This contact closure indicates initiation of SM separation. The contact closure occurs 110 milliseconds prior to physical separation of CM/SM. The

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REVISIONS

[illegible] contact time of the [illegible].

5.1.7 [illegible]

[illegible] [illegible] the Service Module, [illegible].

5.1.8 Lift Off

The "Lift Off" signal will be a switch closure in [illegible] unit. The signal indicates that the IU umbilical has been removed and that the vehicle is in the lift-off phase.

5.1.9 Guidance Reference Release

The Guidance Release signal will be a switch closure in the S-IVB Instrumentation Unit. This signal will indicate that the Saturn IU external pre-launch alignment control has been removed and the IU is inertially stabilized.

5.1.10 Ullage Thrust Present

The Thrust Monitor signal shall be a switch closure in the S-IVB Instrument Unit. The signal shall indicate the presence of thrust on the S-IVB due to ullage.

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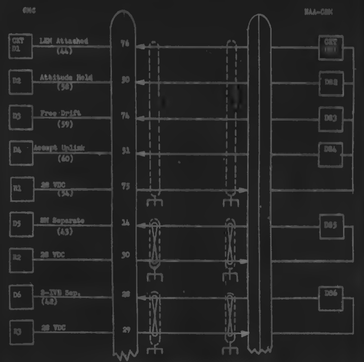
REVISIONS

5.2 Interface Wiring Data



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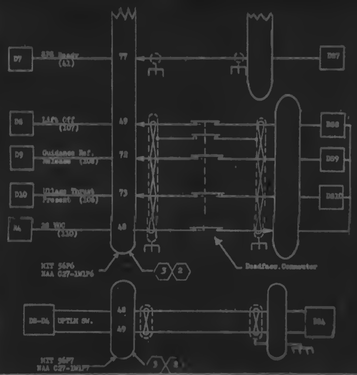
REVISIONS

5.2 Interface Wiring Data (Cont.)



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REVISIONS

All Measurements Between Points A, B, B Reference

Amplitude "1"   28 ± 11 VDC
Amplitude "0"   0 ± 2 VDC

Noise Susceptibility:

DS Open: +80V Noise Pulse, Max Width 1 Millisecond, maximum Rep. Rate 10 pps
DS Closed: -80V Noise Pulse, Max Width 0.5 Millisecond, maximum Rep. rate 10 pps

Circuits

D1, 2, 3, 5, 6, 8, 9, 10
DS1, 2, 3, 5, 6, 8, 9, 10   As Shown Above
R1 - R4

INTERFACE CONTROL DOCUMENT

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SHEET 17

REVISIONS

All Measurements Between Points A, B, B Reference

Amplitude "1"   28 ± 11 VDC
Amplitude "0"   0 ± 2 VDC

Noise Susceptibility:

DS Open: +80V Noise Pulse, Max Width 1 Millisec, maximum Rep. Rate 10 pps
DS Closed: -80V Noise Pulse, Max Width 0.5 Millisec, maximum Rep. Rate 10 pps

*Note: Contact rating of "UPTLM SW.": 28 VDC, 0.5 Amps

Circuits: D4, D7
DS4, DS7   As Shown Above

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REVISIONS

6.0 ATTITUDE SIGNALS FROM GYRO DISPLAY COUPLER (GDC)

This section describes the interface between the CMC and GDC's in the SCS system. The GDC's, driven from the IMAG's, shall provide attitude information to the G&N CMC. The signals shall be in digital form transmitted as two wire signals isolated from ground in both the SCS and CMC. The interface shall consist of six signals (two wires per polarity per axis).

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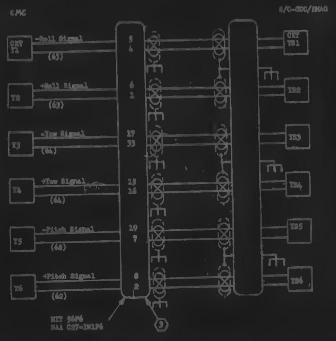
SHEET [illegible]

REVISIONS

6.1 Interface Wiring Data



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03953	A	[illegible]

SHEET [illegible]

REVISIONS

6.2 Circuit and Signal Characteristics

Input Signal Specified at G&N Interface

1. Load Impedance: 200 ± 10% ohms
2. Source Impedance: 100 ohms maximum
3. Signal Characteristics:
   a. Signal Amplitude: (A) 7 ± 3 volts
   b. Pulse Width: (B) 2-4 μ sec (0A/2 point)
   c. Backswing: (C) 4V maximum
   d. Droop: (D) 20% at 2 μ sec point
   e. Rise Time: (10-90% of A) 0.5 μ sec maximum
   f. Zero Volt: The zero volt line is defined as the mean value of the waveform.
   g. Delta Angle: Each pulse appearing on the line shall represent 0.1 ± 8% degrees. The maximum PRR is 640 pps.

NOTE: SCHEMATIC FOR REFERENCE ONLY

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Presence of the pulse shall indicate ... Absence of pulse shall indicate "OFF" condition.

Circuits

T1 - T6 Shown above, CMC Transformer: NASA Drawing 1006219

TS1 - TS6 Shown above

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REVISIONS

7.0 MAIN ENGINE AND SATURN ENGINE CONTROL SIGNALS

This section describes the interface between the CMC and the SPS Drivers. The CMC provides an output-discrete signal to the SPS solenoid driver circuitry to command SPS firing. One line will be provided for this command. The presence of voltage on this line as referenced to spacecraft ground shall command main engine OFF.

In addition, the CMC will provide two signals to the S-IVB Instrument Unit. These signals are:

1. S-IVB Engine Fire Cycle

   This signal will initiate the S-IVB engine firing sequence for translunar injection. The signal shall be a switch closure in the MDP-DSKY causing a 28 VDC signal to be sent to the Saturn Instrument Unit.

2. S-IVB Cutoff

   This signal commands the termination of main engine thrusting. This signal will be initiated by a switch closure in the MDP-DSKY and will send Saturn 28 VDC power back to the Saturn IU.

The 28 VDC power for the above Saturn signals shall be routed from the Saturn Instrument Unit through the Saturn control switch to the DSKY relays on the Main Display Panel.

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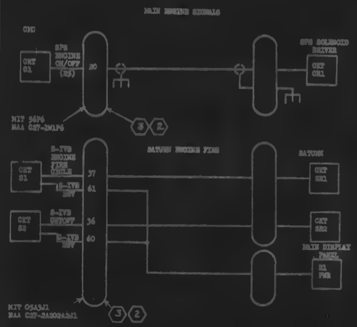
REVISIONS

7.1 Interface Wiring Data



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NOTE: Schematics Shown for Reference Only

All Measurements Made From A to B, B Ref

Amplitude: "ON" 5V ± 5V
"OFF" 28V ± 5V

Current: ON 5 ma Maximum

Source Impedance: "ON" 3K Max to CMC Ground, 0-5 MA Range
"OFF" 0.5 Meg Ohms, 0-40 Volt Range

Source Rise Time: Less than 1μ sec

Noise Rejection: "ON" +20V Noise Pulse, Max Width 0.5 Millisec, Max. Rep. Rate 10 pps
"OFF" -20V Noise Pulse, Max Width 1 Millisec, Max Rep. Rate 10 pps

Circuits: C1 and CR1

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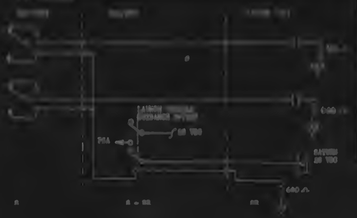

Circuits:

NOTE: SCHEMATICS SHOWN FOR REFERENCE ONLY

S Circuit

Voltage: 28 ± 4 VDC

Current: 0.5 amps Maximum

Switch Shown in OFF Position

S-SS Circuits (Refer to ICD MH01-01344-216 for additional details)

Voltage: 28 ± 4 VDC

Current: 0.5 amps Maximum

SS Circuits

Voltage: 28 VDC Current: 50 Milliamps

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SHEET [illegible]

REVISIONS

6.0 Rotational and Translational Controller Signals

6.0.1 Rotational Hand Controller - The SCS shall provide discrete D-C output signals through the rotational hand controllers to the CMC whenever the controller is activated mechanically by astronaut motion. There shall be six lines representing commands of positive and negative rotation in all three axes from the two controllers.

6.0.2 Translational Hand Controller - The SCS shall provide discrete d-c output signals through the rotation control to the CMC whenever the controller is activated mechanically by astronaut motion. There shall be six lines representing commands of positive and negative translation in all three axes.

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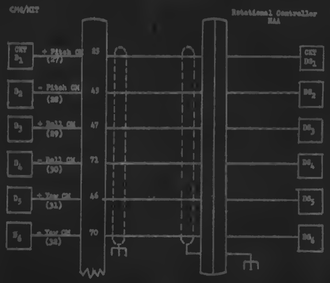
REVISIONS

6.1 Interface Wiring Data

ROTATIONAL CONTROLLER



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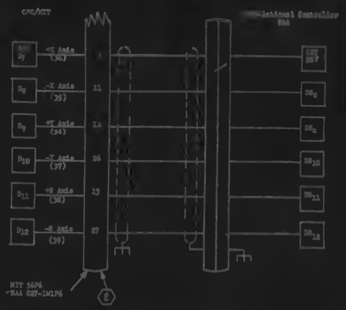
SHEET [illegible]



All measurements made from Points A to B, B Ref.

NOTE: SCHEMATIC FOR REFERENCE ONLY

Circuits

D1 - D12 As shown
DS1 - DS12 As shown

Signal Characteristics:

a. "ON" Signal

(1) Voltage: 28 ± 11 VDC
(2) Current: 0.01 Amps
(3) Source Impedance: 3.9K Ohms Nominal - Rotation Control
1.95 Ohms Nominal - Translation Control

b. "OFF" Signal

(1) Voltage: +2, -5 VDC
(2) Source Impedance: 100K (Minimum)

c. Noise Rejection

(1) DS Open: +80 V noise pulse, maximum width [illegible] millisec maximum rep rate 10 pps
(2) DS Closed: -80 V noise pulse, maximum width 0.5 millisec maximum rep rate 10 pps

REVISIONS

9.0 MASTER CLOCK AND TELEMETRY

9.0.1 Master Clock

The G&N System shall provide a synchronizing pulse from the CMC. This timing pulse will be used to synchronize the NAA Central Timing Equipment with the Computer.

9.0.2 Telemetry

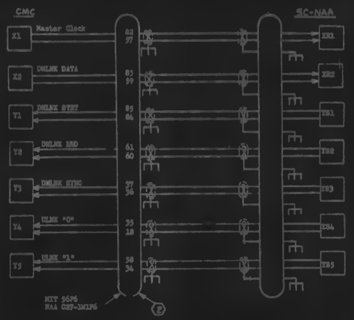
There will be two interfaces with PCM equipment:

1. Downlink - The Downlink shall consist of eight lines, two each for Downlink data, Downlink start, Downlink end, and Downlink sync. This link shall be used to transmit data to the ground via telemetry.

2. Uplink - The uplink will consist of four lines, two each for Uplink "0" and Uplink "1". This link shall be used to transmit data from the ground via Up-Data Link.

REVISIONS

9.1 Interface Wiring Data



REVISIONS

X-Circuits | X - XR | XR-Circuits

NOTE: Schematics Shown for Reference Only

All Measurements Made from A to B, B Ref.

1. Load Impedance - 500 ohms (approximate)
2. Source Impedance:
   a. Impedance during pulse - 100 ohms (approx)
   b. Resistance of Winding - 10 ohms maximum
   c. Inductance of winding - 10 mh (maximum)

INTERFACE CONTROL DOCUMENT

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REVISIONS

a) Amplitude (A) = 4 to 14 volts
b) Pulse width (B) = 0.5 ± 0.25 μ sec.
c) Zero Shift (D) = 50% of A (approx.)
d) Rise time (10% to 90% of A) = 0.2 μ sec. max.
e) Noise and ripple - 0.2 volts max.
f) Frequency - 1024 KC ± 2 PPM
g) Zero volt line is defined as the mean value of the waveform.
h) Grounding: The master clock output signal end shall be ground isolated in the G&N System.
i) Presence of pulse shall indicate "ON" condition.
   Absence of pulse shall indicate "OFF" condition.

Circuits

X1 Shown above, GMC Transformer: NASA Drawing No. 1006319

XR1 Shown Above

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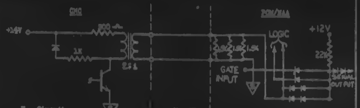
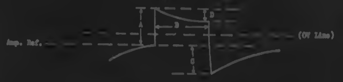
		SHEET [illegible]

REVISIONS

9.2 Continued





Interface Signal Specified at G&N Interface

1. Load Impedance: 500 ± 10% ohms nominal, note XR circuit above.
2. Source Impedance: 100 ohms maximum, note X circuit above.
3. Signal characteristics at the G&N Interface
   (Test load of 510 ohms ± 10% acceptable)
   a. Amplitude (A) 7 ± 3V
   b. Pulse Width (B) 2.5 to 6 μ sec. at A/2 Point
   c. Backswing (C) 6V maximum
   d. Droop (D) 15% of "A" maximum at 2 μ sec. maximum

NOTE: SCHEMATICS SHOWN FOR REFERENCE ONLY

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REVISIONS

9.2 Continued

e. Rise Time (10-90% of A) 0.2 μ sec maximum

f. Zero Volt: The zero volt line is defined as the mean value of the waveform and is determined by the pulse shape and repetition rate.

g. Noise Specification
   1. Noise during the transmission of the pulse:
      The signal plus noise shall remain with the envelope of amplitude defined above (A,B).
   2. Noise during the absence of the pulse:
      +0.4 volts max, -4.0 volts max; measured with respect to the amplitude reference (see Figure).

h. Presence of the pulse shall indicate "ON" condition.
   Absence of pulse shall indicate "OFF" condition.

Circuits

X2 shown above, GMC transformer: NASA Drawing No. [illegible]

XR2 to be furnished, NAA

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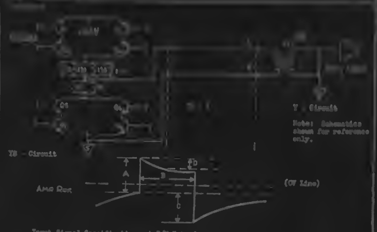
CODE IDENT NO.	SIZE	
03953	A	[illegible]

REVISIONS



Input Signal Specifications at G/N Interface

1. Load impedance: 200 ohms nominal, note Y circuit above.
2. Source Impedance: 100 ohms max.
3. Signal characteristics at G/N interface (Test load of 200 ohms ± 10% acceptable)
   a. Amplitude (A) 4.5 ± 2V
   b. Pulse Width (B) 4.5 ± 1.5μsec (at A/2 point)
   c. Droop (D) 15 % of "A" at 2μ sec max
   d. Rise Time (10-90% of A) 0.2μ sec max
   e. Zero Volt: The zero volt line is defined as the mean value of the waveform and is determined by the pulse shape and repetition rate.

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REVISIONS

[illegible] Continued

g) [illegible]

[illegible]

h) [illegible] of the pulse sha[illegible]
Absence of pulse shall indicate "[illegible]" condition.

Circuits

Y1 - Y3 shown above, GMC transformer: NASA Drawing No. 1006319

YS1 - YS3 to be furnished, NAA

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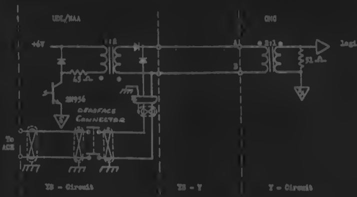
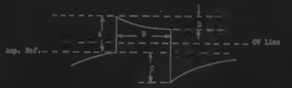
REVISIONS

9.2 Continued



NOTE: Schematics shown for reference only.



Input Signal Specifications at G&N Interface

1. Load Impedance: 200 ohms nominal, note Y circuit above.
2. Source Impedance: (Maximum) 280 Ω During Pulse

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REVISIONS

9.2 Continued

3. Signal Characteristics at G&N Interface (Test load of 200 ohms ± 10% acceptable)
   a. Amplitude (A) 7 ± 3V
   b. Pulse Width (B) 2-6μ sec (at A/2 point)
   c. Backswing (C) 4V maximum
   d. Droop (D) 20% of "A" maximum
   e. Rise Time (10-90% of A) 1μ sec maximum
   f. Zero Volt: The zero volt line is defined as the mean value of the waveform and is determined by the pulse shape and repetition rate.
   g. Noise Specification
      1. Noise during the transmission of the pulse:

         The signal plus noise shall remain within the envelope of amplitude defined above (A, B).

      2. Noise During the absence of the pulse:

         +0.4 volts maximum, -4.0 volts maximum; measured with respect to the amplitude reference (see Figure).
   h. Presence of the pulse shall indicate "ON" condition. Absence of the pulse shall indicate "OFF" condition.

Circuits

Y4 - Y5 Shown above, GMC transformer: NASA Drawing No. 1006319

YS4 - YS5 To be furnished, NAA

INTERFACE CONTROL DOCUMENT

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a. Start pulses: Normal rate 50 pps, low rate 10 pps.

b. Bit sync pulses: Normal rate 51.2 Kpps, low rate 1.6 Kpps. There will be 40 pulses per burst.

c. Data pulses: Frequency and width determined by bit sync pulses. A "1" is the presence of a pulse and a zero as the absence of a pulse with a bit sync pulse.

d. Stop pulses: Normal rate 50 pps, low rate 10 pps.

e. During CMC "Standby Mode", data is all "1's".

* Time shown held for normal data rate; for low data rate replace 19.5 ± 5 µ sec by 625 ± 156 µ sec.

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a. Bit rate of 0's and [illegible]'s is [illegible] Kpps maximum.

b. A word is composed of 16 pulses; a "wake up" bit on the [illegible] [illegible] followed by 15 bits on the "1" [illegible] "0" lines.

c. Minimum time between words is 0.1 seconds.

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REVISIONS

10.0 CM Computer Display Keyboard (DSKY) Illumination Power

This section covers the electrical interface for the MDC-DSKY and the LEB-DSKY Illumination. NAA will provide power and dimming controls for EL integral lighting (keys), alpha numerics, and the advisory and component status lights.

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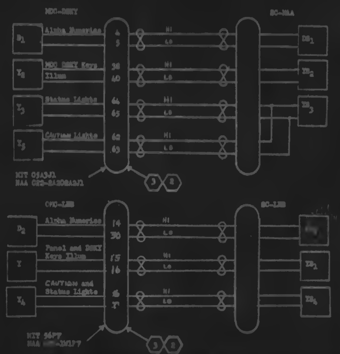
09963	A	[illegible]

REVISIONS

10.1 Interface Wiring Data



INTERFACE CONTROL DOCUMENT

NORTH AMERICAN AVIATION, INC.

[illegible]

[illegible] Measurements Made from A to B, B Reference

Waveform: 800 cps Square Wave, 14 VDC maximum,

Current: 2MA Maximum

Dimmer Control:

Type [illegible] 5%
Taper (3) (2)

Circuits:

[illegible] and D_2
DS_1 and DS_2

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NOTE: SCHEMATIC FOR REFERENCE ONLY

All Measurements Made from A to B, B Reference

Voltage: 115V ± 4.3 (Controlled 0 - 115 VAC)

Current: 317.5 MA @ 75V (APPROXIMATE)

Frequency: 400 cps ± 7 cps

VA: 23.8

Watts: 10.66

P.F.: 0.5

Noise: Modulation: 0.5 percent

Transients: 50 to 150 volts RMS Recovery in 30 milliseconds to steady state.

Circuits: Y_1
YS

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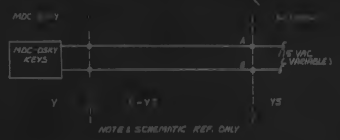
REVISIONS

10.2 Circuit and Signal Characteristics (Cont.)



All Measurements made from A to B, B Reference

Voltage: 115V ± 4.3 (Controlled 0 - 115 VAC)

Current: 17.5 MA @ 75V (APPROXIMATE)

Frequency: 400 cps ± 7 cps

VA: 1.32
Watts: 0.66
P.F.: 0.50

Noise: Modulation: 0.5 percent
Transients: 50 to 150 volts RMS Recovery in 30 milliseconds to Steady State.

Circuits:

[illegible]
[illegible]

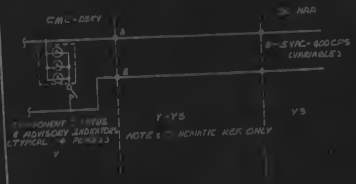
INTERFACE CONTROL DOCUMENT

NORTH AMERICAN AVIATION, INC.

CODE IDENT NO.	SIZE	
[illegible]	A	[illegible]

REVISIONS

10.2 Circuit and Signal Characteristics (Cont.)



All Measurements made from A to B, B Reference

Voltage: 5 VAC variable to Off

Current: 0 180 amps per Display
(2.5 amps maximum drain on S/C System - for Lamp Test Only)

Operational Current: 720 MA (approximate)

Circuits:

Y_3 and Y_4, Y_5 As Shown Above
YS_3 and YS_4,

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[illegible]	A	[illegible]

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REVISIONS

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REVISIONS

11. (Cont)

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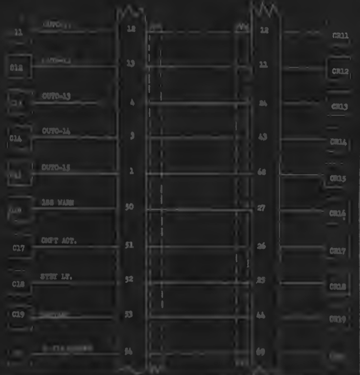
CODE IDENT NO. [illegible]	SIZE A — [illegible] — SHEET [illegible]

REVISIONS

11.1 (Cont.)



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11.2 Circuit and Signal Characteristics

Waveform Specs

D Circuit

Volt. Amp.	0 - 28
Rise Time	< 1 μ sec.
Current Amp.	2 MA Maximum
Rise Time	< 1 μ sec.
Frequency	2 PPS maximum

C Circuit

Volt. Amp.	0 - 28
Rise Time	< 1 μ sec.
Current Amp.	5 MA Maximum
Rise Time	< 1 μ sec.

W Circuit

W1	Ground
W2	Spare
W3 Current	100 ma or less
W4 Current	250 ma (pulsating)

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REVISIONS

12.0 CMC ... to Spacecraft Displays

This interface covers the signals from the CMC which illuminate the caution and warning lights in the "Caution and Warning" subsystem.

There shall be three signals:

1. CMC (Warning) - Indicates a malfunction in the CMC Power Supply or CMC Circuit
2. ISS (Warning) Inertial Subsystem - Indicates a malfunction in the IMU, PIPA Loop, CDU.
3. PGNS (Caution) Primary Navigation/Guidance System - Indicates Gimbal Lock, IMU Temp out of Tolerance, Radar Failure, Program Alarm, Restart (computer).

INTERFACE CONTROL DOCUMENT

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REVISIONS

[illegible]

* Red Light

** Yellow Light

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[illegible]

measurements made from A to [illegible], B Ref.

Voltage: 28 VDC (nominal from S/C [illegible])

Current: 120 ma Steady State
1 amp peak for 10 milliseconds

Contact Rating: 0.5 amps (+28 VDC into lamp load)

<u>Circuits</u>

SD1 SD3 as shown above

SR1 - SR3

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REVISIONS

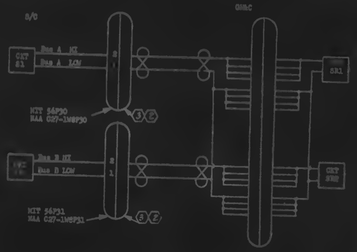
13.0 Computer to Spacecraft Power

This interface covers the Power interface to the AGC and is included in this ICD for reference only. The Power Interface for the G/N and C shall be covered in ICD MH01-01327-216.

INTERFACE CONTROL DOCUMENT

REVISIONS

13.1 Interface Wiring Data



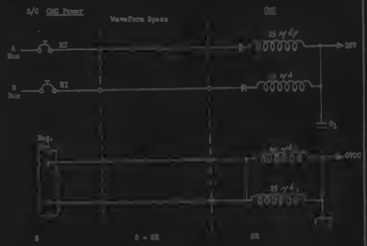
NOTE: For Reference Only

INTERFACE CONTROL DOCUMENT

REVISIONS

.2 Interface Circuit and Signal Characteristics

S/C CMC Power



All Measurements at CMC Interface

Voltage: 25.8 to 30.8 at CMC Interface
Transients: Per MH01-01327-216
Current: 4 amps maximum

Circuits

S1, S2
SR1, SR2

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REVISIONS A

[illegible] 28860 MAY 17 1966

APPROVALS

AUTHORIZED SIGNATURES	REPRESENTING	DATE
[illegible signature]	NAA/S&ID	[illegible]
D. G. Hoag / W. [illegible]	MIT	6 Oct 65

INTERFACE CONTROL DOCUMENT

DR BY	A. Silagyi
CHK BY	

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COMMAND MODULE GUIDANCE COMPUTER ELECTRICAL INTERFACES BLOCK II NAA-MIT

CODE IDENT NO. 03953 — SIZE A — MH01-01380-216

REVISIONS

[illegible] 28860 MAY 17 1966

MODEL	PART NO.	DESCRIPTION	APPLICABLE SPEC
V36-3	V36-780001	Command Module Ser. No. 98,101-118	SID64-1347,1399,1890-2

EFFECTIVITY AND SPECIFICATIONS

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REVISIONS A 1-10-66

SYM	DESCRIPTION	REQD	REP	DATE	APPROVED
A	1. Sheet 2: Added Effectivity and Specifications Information				
	2. Sheet 4: Remove Note (3)				
	3. Sheet 5: Section 10 - Changed CGC to CMC.				
	4. Sheet 8: (a) Changed CGC to CMC (b) Added Notes 1 & 2				
	5. Sheet 11: (a) Added Connector Reference Designator (b) Added Notes 1 & 2				
	6. Sheet [illegible]: Added "Min" after Source Impedance "OFF" 0.5 Meg Ohms "Min".				
	7. Sheet 16: Added Connector Reference Designators and notes (1) & (2)				
	8. Sheet 17: (a) Changed "Noise Susceptibility" TO: "Noise Rejection"				
	(b) Changed "DS Open" to "ON" and Max Width 1 Millisec [illegible] "Max Width .5 Millisec.				
	(c) Changed "DS Closed" to "OFF" and Maximum width 0.5 Millisec to "Maximum Width 1 Millisec".				
	9. Sheet 20: Added Connector Reference Designator and Notes (1) & (2).				
	10. Sheet 21: 3g Added "Spurious Pulses will not exceed one (1) per 100 second period" after last sentence.				
	11. Sheet 24: Added Reference Designators and Notes (1) & (2)				

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REVISIONS A 1-10-66

SYM	DESCRIPTION	REQD	REP	DATE	APPROVED
	[illegible]				

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REVISIONS

SYM	DESCRIPTION	REQD	REP	DATE	APPROVED
	[illegible]				

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CODE IDENT NO. 03953 | SIZE A | MH01-01380-216

REVISIONS [illegible]

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(1) [illegible] Te[illegible]
[illegible]
Cambridge, Ma[illegible]

(2) [illegible] American [illegible]
[illegible] and [illegible]
[illegible]

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T[illegible] OF [illegible]

1.0 [illegible]
2.0 [illegible] Form and Noise Measurement Techniques
3.0 [illegible] [illegible]ls
4.0 [illegible] Jet [illegible] Signals
5.0 [illegible] Mode and [illegible]tus Signals
[illegible] [illegible]tude Signals from GDC/BMAG
[illegible] [illegible] Engine Signals
8.0 [illegible]ional and Translational [illegible] Signals
[illegible] [illegible] and Te[illegible]
[illegible] CMC/DSKY [illegible]
[illegible] Computer to Computer Displays
11.0 [illegible] to [illegible] Displays
[illegible] Computer [illegible] Power

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1.0 SCOPE

This ICD defines all of the electrical interfaces that are associated with the Command Module Guidance Computer. It will specify the characteristics, wiring, and shielding of each.

There are various input and output circuits associated with the CMC. These circuits are categorized as follows:

Y, YS - Y: Input transformer circuit; YS: source for "Y" circuit.
X, XR - X: Output transformer circuit; XR: receiver of "X" circuit.
D, DS - D: DC input circuitry; DS: source for the "D" circuit.
C, CR - C: DC output circuit; CR: receiver for "C" circuit.
S, SR - S: Switch closure; SR switch closure receiver.
W, WR - W: Just a wire connection; WR: receiver for "W".
E - E: DC power source.

The numbers following any particular designation (CS, XS, CR2, DS2, etc.) together with the section numbers uniquely designates a particular CMC output circuit or input circuit.

1.1 Grounding Symbology

The following drawing symbology shall be used throughout this ICD:

a) AC Grounds
   1. AC Power
   2. AC Signal
b) DC Ground
   1. DC Power
   2. DC Signal Ground
c) Isolated Circuit Ground
d) Structure Ground
e) Vehicle Ground Point

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3.0 Waveform and Noise Measurement Techniques

1. Pulse Measurements

a. Measurements to be made at points indicated in appropriate sections of this ICD.

b. Measurements to be made with Tektronix 540 series, type 1A1 differential preamp, 10/1 attenuator probes; or equivalent. Scope to be grounded at GSE only, if at all.

2. Noise Measurements

a. Measurements to be made with Tektronix 540 series, type CA preamp, and P6016 current probe and type 131 amplifier; or equivalent.

b. The current to voltage conversion factor will be the load pulse impedance (250 ohms; XX, Y) or DC impedance (25K ohms; CR, D) where applicable.

3. AC Measurements

a. Hewlett-Packard 400D or equivalent.

4. DC Measurements

a. Scope or equivalent.

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4.0 AGC to SCS Drivers

This section describes the interface between the Apollo Guidance Computer and the SCS Reaction Control System. The Apollo Guidance Computer will provide output-discretes to SCS reaction jet drivers to command reaction jet firing. There will be a total of 16 output lines provided, each line carrying the ignition command for one of the 16 S/M reaction jets for commanding vehicle rotation and translation or one of the 12 C/M reaction jets for commanding vehicle rotation only. The remaining four lines have no function after the SM is detached. The presence of high voltage on a line as referenced to spacecraft ground will indicate a jet OFF discrete.

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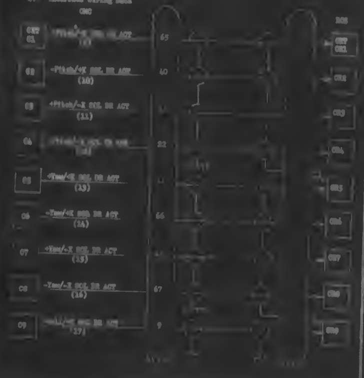
4.1 Interface Wiring Data



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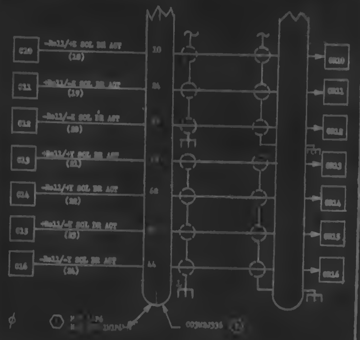
4.1 Interface Wiring Data (Continued)



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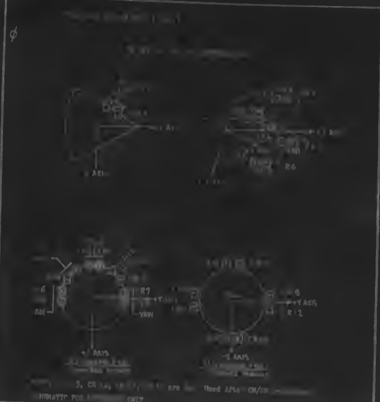

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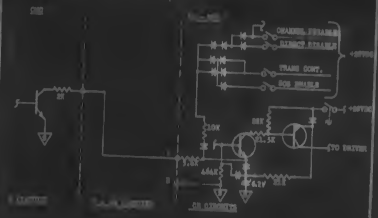
4.2 Circuit and Signal Characteristics



All Measurements Made from A to B, B Ref.

Amplitude:	"ON"	5VDC ± 5 VDC	Circuits:	C1-C16	Shown Above
	"OFF"	28VDC ∓ 5 VDC		CR1-CR16	Shown Above
Current:	"ON"	5 MA Max.			
Source Impedance:	"ON"	3K Max to CMC Gnd, 0-5 MA Range			
	"OFF"	0.5 Meg Ohms Min. 0-40 Volt Range			
Source Rise Time:		Less than 1 μ sec.			
Noise Rejection:	"ON"	+20V Noise pulse, max width 0.5 millisec, maximum rep rate 10 pps			
	"OFF"	-20V Noise pulse, max width 1 millisec, maximum rep rate 10 pps			

NOTE: SCHEMATICS SHOWN FOR REFERENCE ONLY

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5.0 CONTROL MODE AND STATUS SIGNALS

5.1 Signal Definitions

5.1.1 LEM Attached (△V CG, LEM/CSM - CSM)

The LEM Attached signal will be a switch closure on the Command Module Main Display Panel. This switch closure will be pilot initiated upon completion of LEM transposition and docking.

5.1.2 SPS Ready (△V Thrust, Normal - Off - Direct On)

The SPS Ready signal will be provided by a switch closure on the Command Module Main Display Panel. This switch closure will be pilot initiated and will indicate procedurally the completion of the pre Delta V checkout procedure. The SPS engine cannot be fired unless this discrete is present.

5.1.3 Attitude Hold (SC Control, CMC, Auto - Hold - Free)

The Attitude Hold signal will be a switch closure on the Command Module Main Display Panel. This switch will be pilot initiated at such time, during primary control, as it is desired to hold the present attitude of the spacecraft.

5.1.4 Free Drift (SC Control, CMC, Auto - Hold - Free)

The Free Drift signal will be a switch closure on the Command Module Main Display Panel. This switch will be pilot initiated at such time, during primary control, as it is desired to inhibit automatic control and permit manual control of the spacecraft through the RHC (hand controllers, minimum impulse).

5.1.5 Accept Uplink (UPTLM, Accept - Block)

The Accept Uplink signal will be a switch closure on the Command Module Main Display Panel. This switch will be pilot initiated at such time as it is desired to receive information via the update link. A similar switch shall be provided in the LEM. Both switches must be in accept position to receive uplink data.

5.1.6 C/M - S/M Separate

The Service Module Separation signal will be a parallel contact closure within the SM/CM Reaction Jet Control Transfer Unit. This contact closure indicates initiation of SM separation. The contact closure occurs 110 milliseconds prior to physical separation of CM/SM. The

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switch transfer time is 100 milliseconds maximum.

5.1.7 SIV-B Separate

The S-IVB Booster Separation Signal will be a contact closure within the Spacecraft Master Events, Sequence Controller. This contact closure indicates S-IVB booster separation and shall occur simultaneously with the firing of the Service Module, LEM Adapter (SLA) separation Pyros.

5.1.8 Lift Off

The "Lift Off" signal will be a switch closure in the S-IVB Instrumentation Unit. The signal indicates that the IU umbilical has been removed and that the vehicle is in the lift-off phase.

5.1.9 Guidance Reference Release

The Guidance Release signal will be a switch closure in the S-IVB Instrumentation Unit. This signal will indicate that the Saturn IU external pre-launch alignment control has been removed and the IU is inertially stabilized.

5.1.10 Ullage Thrust Present

The Thrust Monitor signal shall be a switch closure in the S-IVB Instrument Unit. The signal shall indicate the presence of thrust on the S-IVB due to ullage.

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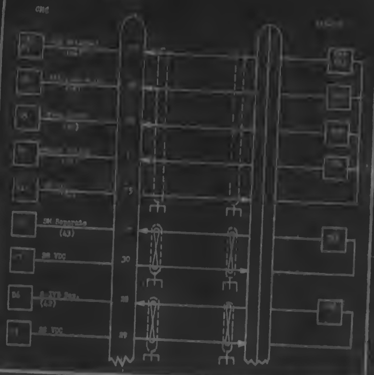

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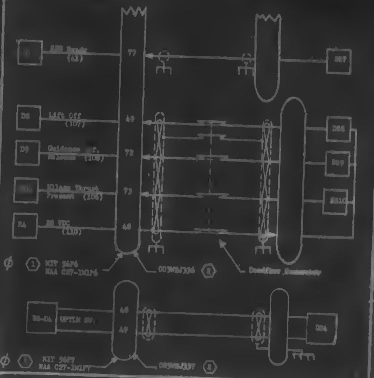
5.2 Interface W[illegible]ing Data (Cont.)



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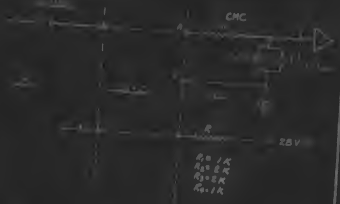
5.3 Circuit and Signal Definition



$R_1 = 1K$
$R_2 = 2K$
$R_3 = 2K$
$R_4 = 1K$

Measurements Between [illegible] 2 Reference

[illegible]tude "1" 28 ± 11 VDC
[illegible]itude "0" [illegible] 2 [illegible]

Noise Rejection:

ON": +[illegible]V Noise Pulse, Max Width, [illegible] Millisecond, maximum [illegible] Rate 10 pps

OFF": -[illegible]V Noise Pulse, Max Width 1.0 Millisecond, maximum Rep. rate 1 pps

[illegible]

[illegible] 3, [illegible] 8, 9, 10
[illegible] 3, [illegible] 8, 9, 10 As Shown Above

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5.3 Circuit and Signal Definition

All Measurements Between Points A, B, B Reference

Amplitude "1" 28 ± 11 VDC
Amplitude "0" 0 ± 2 VDC

Noise Rejection:

"ON": +60V Noise Pulse, Max Width .5 Millisec, maximum Rep. Rate 20 pps
"OFF": ±20V Noise Pulse, Max Width 0.0 Millisec, maximum Rep. Rate 20 pps

*Note: Contact rating of "UPTLM SW.": 28 VDC, 0.5 Amps

Circuits: DA, D7 / DAA, D87 — As Shown Above

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6.0 ATTITUDE SIGNALS FROM GYRO DISPLAY COUPLER (GDC)

This section describes the interface between the GNC and GDC's in the SCS system. The GDC's, driven from the BMAG's, shall provide attitude information to the G&N GNC. The signals shall be in digital form transmitted as two wire signals isolated from ground in both the SCS and GNC. The interface shall consist of six signals (two wires per polarity per axis).

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6.1 Interface Wiring Data

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6.2 [illegible] and Signal Characteristics

Input [illegible] Specified at G&N Interface

1. [illegible] Impedance: [illegible] 10% ohms
2. [illegible] Impedance: [illegible] ohms maximum
3. [illegible] Characteristics
   a. [illegible] Amplitude [illegible] 7 ± 3 volts
   b. [illegible] Width [illegible] µ sec (A/2 point)
   c. [illegible] Skewing: [illegible] 4V maximum
   d. Droop [illegible] 20% at 2 µ sec po[illegible]
   e. [illegible] Rise Time (10-90% of A) 0.5 µ sec [illegible]
   f. Zero Volt: The zero volt line is defined as the mean [illegible] of the wave-form.
   g. [illegible] Angle [illegible] pulse appearing on the [illegible] shall represent 0.[illegible] degrees. The maximum PRR is 640 [illegible]
   h. [illegible] Offset [illegible] less than [illegible] ([illegible] pulse per 100 [illegible]) with equal to or greater than [illegible] rate input [illegible] the [illegible] assembly.

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6.2 (Continued)

b. Noise Specification

1. Noise during the transmission of the pulse: The signal plus noise shall remain within the envelope of amplitude defined above (A,B)

2. Noise during the absence of the pulse: +0.4 volts max, -4.0 volts max; measured with respect to the amplitude reference (See Figure).

3. Presence of the pulse shall indicate "ON" condition. Absence of pulse shall indicate "OFF" condition.

Circuits

T1 - T6 Shown above, ONE Transformer: NASA Drawing 1006319

TS1 - TS6 Shown above

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7.0 MAIN ENGINE AND SATURN ENGINE CONTROL SIGNALS

This section describes the interface between the CMC and the SPS Drivers. The CMC provides an output-discrete signal to the SPS solenoid driver circuitry to command SPS firing. One line will be provided for this command. The presence of voltage on this line as referenced to spacecraft ground shall command main engine OFF.

In addition, the CMC will provide two signals to the S-IVB Instrument Unit. These signals are:

1. S-IVB Engine Fire Cycle

This signal will initiate the S-IVB engine firing sequence for translunar injection. The signal shall be a switch closure in the NSP-DSKY causing a 28 VDC signal to be sent to the Saturn Instrument Unit.

2. S-IVB Cutoff

This signal commands the termination of main engine thrusting. This signal will be initiated by a switch closure in the NSP-DSKY and will send Saturn 28 VDC power back to the Saturn IU.

The 28 VDC power for the above Saturn signals shall be routed from the Saturn Instrument Unit through the Saturn control switch to the DSKY relays on the Main Display Panel.

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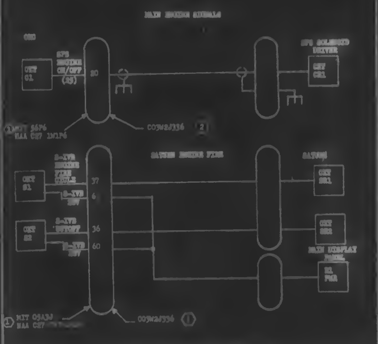
7.1 Interface Wiring Data



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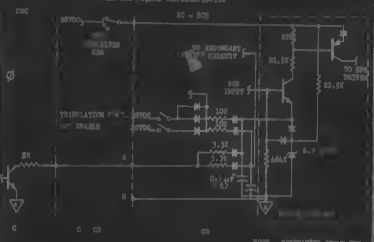
7.2 Interface Circuit and Signal Characteristics



NOTE SCHEMATICS SHOWN FOR REFERENCE ONLY

All Measurements Made from [illegible] to B, D Ref:

Amplitude	"ON"	5V [illegible] 5V
	"OFF"	28V [illegible] 5V
Current:	ON 5 MA Maximum	
Source Impedance:	"ON"	3K Max to CMC Ground, 0-5MA Range
	"OFF"	0.5 Meg Ohms, [illegible] Volt Range
[illegible] Rise Time	Less than [illegible] μs sec.	
Noise Rejection	"ON"	+80V Noise Pulse, Max Width 0.5 Millisec, Maximum Rep. Rate 10 pps
	"OFF"	20V Noise Pulse, Max Width [illegible] Millisec, Maximum Rep. Rate 10 PPS

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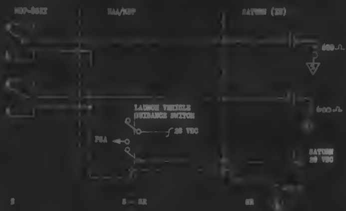
7.2 Continued



NOTE: SCHEMATICS SHOWN FOR REFERENCE ONLY

Circuits:

S Circuit

Voltage: 28 ± 4 VDC

Current: 0.5 amps Maximum

Switch Shown in OFF Position

S-SR Circuits (Refer to ICD MH01-01344-216 for additional details)

Voltage: 28 ± 4 VDC

Current: 0.5 amps Maximum

SR Circuits

Voltage: 28 VDC Current: 50 Milliamps

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8.0 Rotational and Translational Controller Signals

8.0.1 Rotational Hand Controller – The SCS shall provide discrete D-C output signals through the rotational hand controllers to the GMC whenever the controller is activated mechanically by astronaut motion. There shall be six lines representing commands of positive and negative rotation in all three axes from the two controllers.

8.0.2 Translational Hand Controller – The SCS shall provide discrete d-c output signals through the rotation control to the GMC whenever the controller is activated mechanically by astronaut motion. There shall be six lines representing commands of positive and negative translation in all three axes.

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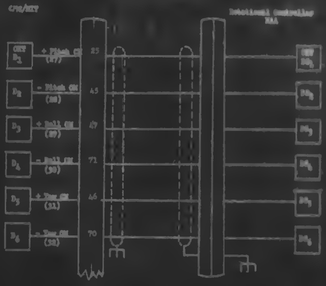
8.1 Interface Wiring Data



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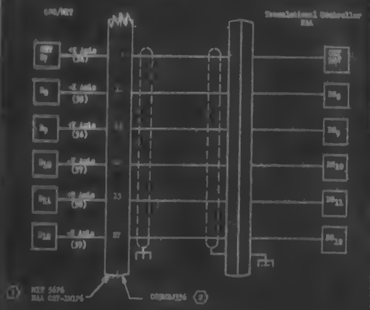
8.1 Interface Wiring Data (Continued)



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8.2 Interface Circuit and Signal Characteristics

NOTE: SCHEMATIC FOR REFERENCE ONLY

All measurements made from Points A to B, B Ref.

Signal Characteristics:

Circuits

D1 - D12 As shown
D81 - D812 As shown

a. "ON" Signal

(1) Voltage: 28 ± 11 VDC
(2) Current: 0.01 Amps
(3) Source Impedance: 3.9K Ohms Nominal - Rotation Control; 1.95 Ohms Nominal - Translation Control

b. "OFF" Signal

(1) Voltage: +2, -5 VDC
(2) Source Impedance: [illegible] (Minimum)

c. Noise Rejection

(1) "ON" +[illegible] V noise pulse, maximum width .5 millisec maximum rep rate 10 pps
(2) "OFF" -[illegible] V noise pulse, maximum width 2.0 millisec maximum rep rate 10 pps

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9.0 MASTER CLOCK AND TELEMETRY

9.0.1 Master Clock

The G&N System shall provide a synchronizing pulse from the CMC. This timing pulse will be used to synchronize the NAA Central Timing Equipment with the Computer.

9.0.2 Telemetry

There will be two interfaces with PCM equipment:

1. Downlink - The Downlink shall consist of eight lines, two each for Downlink data, Downlink start, Downlink end, and Downlink sync. This link shall be used to transmit data to the ground via telemetry.

2. Uplink - The uplink will consist of four lines, two each for Uplink "0" and Uplink "1". This link shall be used to transmit data from the ground via Up-Data Link.

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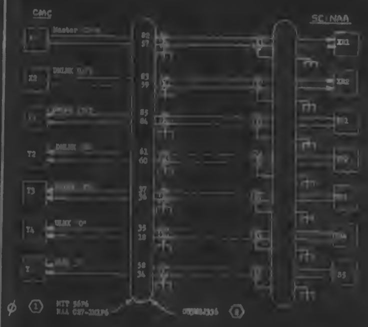
9.1 Interface Wiring Data



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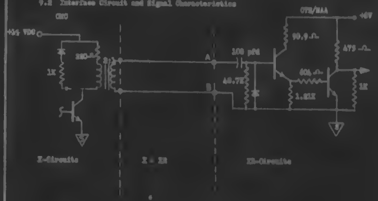
9.2 Interface Circuit and Signal Characteristics



NOTE: Schematics Shown for Reference Only

All Measurements Made from A to B, B Ref.

1. Load Impedance - 500 ohms (approximate)
2. Source Impedance:
   a. Impedance during pulse - 100 ohms (approx)
   b. Resistance of Winding - 10 ohms maximum
   c. Inductance of winding - 10 mh (maximum)

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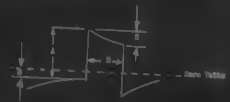
REVISIONS A [illegible]

.2 Continued

3. Signal Characteristics at GN&C Interface
(Test load of 510 ohms)



a) Amplitude (A) = 4 to 14 volts
b) Pulse width (B) = 0.5 ± 0.25 μ sec.
c) Zero Shift (D) = 50% of A (Approx.)
d) Rise time (10% to 90% of A) = 0.2 μ sec. max.
e) Noise and ripple - 0.2 volts max.
f) Frequency = 1024 KC ± 2 PPM
g) Zero volt line is defined as the mean value of the waveform.
h) Grounding: The master clock output signal and shall be ground isolated in the G&N System.
i) Presence of pulse shall indicate "ON" condition.
Absence of pulse shall indicate "OFF" condition.

Circuits

X1 Shown above, CMC Transformer: NASA Drawing No. [redacted]

XR1 Shown Above

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9.2 Continued

Interface Signal Specified at G&N Interface

1. Load Impedance: 500 ± 10% ohms nominal, note XR circuit above.

2. Source Impedance: 100 ohms maximum, note X circuit above.

3. Signal characteristics at the G&N Interface
(Test load of 510 ohms ± 10% acceptable)

a. Amplitude (A) 7 ± 3V

b. Pulse Width (B) 2.5 to 6 μ sec. at A/2 Point

c. Backswing (C) 4V maximum

d. Droop (D) 15% of "A" maximum at 2 μ sec. maximum

NOTE: SCHEMATICS SHOWN FOR REFERENCE ONLY

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9.2 Continued

e. Rise Time (10-90% of A) 0.2 μ sec maximum

f. Zero Volt: The zero volt line is defined as the mean value of the waveform and is determined by the pulse shape and repetition rate.

g. Noise Specification

1. Noise during the transmission of the pulse:
The signal plus noise shall remain with the envelope of amplitude defined above (A,B).

2. Noise during the absence of the pulse:
+0.4 volts max, -4.0 volts max; measured with respect to the amplitude reference (see Figure).

h. Presence of the pulse shall indicate "ON" condition.
Absence of pulse shall indicate "OFF" condition.

Circuits

X2 shown above, CMC transformer: NASA Drawing No. 1006316

XR2 to be furnished, NAA

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[illegible] ions at [illegible] Interface
[illegible] impedance 200 ohms nominal, note [illegible] circuit above.

[illegible] ohms max.

[illegible] characteristics at [illegible] interface
[illegible] ohms ± 10% acceptable)

a. [illegible] (A) 4.5 ± 1V

b. [illegible] 4.5 [illegible] μsec (at A/2 [illegible])

c. [illegible] % [illegible] 2 μ sec [illegible]

d. [illegible] (10-90% [illegible]) [illegible] 2 μ sec [illegible]

e. Zero [illegible] the zero volt [illegible] is [illegible] as the mean value of the waveform and is determined by the [illegible] and repetition rate.

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9.2 Continued

g. Noise Specification

1. Noise during the transmission of the pulse:
The signal plus noise shall remain within the envelope of amplitude defined above (A,B).

2. Noise during the absence of the pulse:
+0.4 volts max, -4.0 volts max; measured with respect to the amplitude reference (see Figure).

h. Presence of the pulse shall indicate "ON" condition.
Absence of pulse shall indicate "OFF" condition.

Circuits

T1	- T3	shown above, CMC transformer: NASA Drawing No. 1006319
TB1	- TB3	to be furnished, NAA

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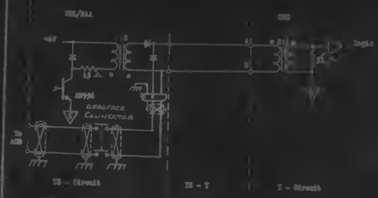
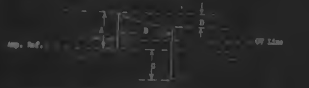
9.2 Continued



NOTE: Schematics shown for reference only.



Input Signal Specifications at GAN Interface

1. Load Impedance: 200 ohms nominal, note T circuit above.
2. Source Impedance: (Maximum) 230 Ω During Pulse

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9.2 Continued

3. Signal Characteristics at GAN Interface
(Test load of 200 ohms ± 10% acceptable)

a. Amplitude (A) 7 ± 3V
b. Pulse Width (B) 2-4 μsec (at A/2 point)
c. Backswing (C) 4V maximum
d. Droop (D) 20% of "A" maximum
e. Rise Time (10-90% of A) 1 μsec maximum
f. Zero Volt: The zero volt line is defined as the mean value of the waveform and is determined by the pulse shape and repetition rate.
g. Noise Specification
   1. Noise during the transmission of the pulse:
      The signal plus noise shall remain within the envelope of amplitude defined above (A, B).
   2. Noise During the absence of the pulse:
      +0.4 volts maximum, -4.0 volts maximum; measured with respect to the amplitude reference (see Figure).
h. Presence of the pulse shall indicate "ON" condition.
Absence of the pulse shall indicate "OFF" condition.

Circuits

T4 - T5	Shown above, CMC transformer: NASA Drawing No. 1006319
TB4 - TB5	To be furnished, NAA

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[illegible] Continued

[illegible] Timing

a. [illegible] pulses: Normal rate 50 pps, low rate [illegible] pps.

b. [illegible] sync pulses: Normal rate 51.[illegible] Kpps, low rate 1.6 [illegible].
There will be 40 pulses per burst.

c. [illegible] pulses: Frequency and width determined by bit sync pulses.
[illegible] is the presence of a pulse and a zero as the absence of a pulse with a bit sync pulse.

d. [illegible] pulses: Normal rate 50 pps, low rate [illegible] pps.

e. During CMC "Standby Mode", data is all "1's".

* Time shown hold for normal data rate; for low data rate replace 19.[illegible] μ sec by 625 ± 156 μ sec.

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[illegible]

- [illegible]
- [illegible] pulses; a "wake up" [illegible] time followed by [illegible] the [illegible] "0" lines.
- [illegible] time between words [illegible] 0. [illegible] seconds.

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[illegible]

[illegible] vers [illegible] for the [illegible] and [illegible] Illumination. NAA [illegible] and dimming controls [illegible] integral lighting (keys), [illegible] numerics, and the advisory and component status [illegible].

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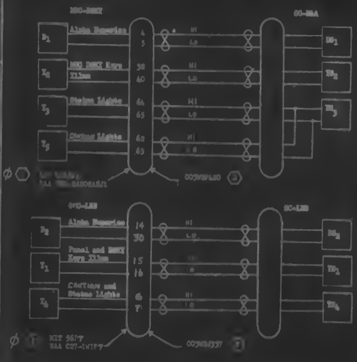
10.1 Interface Wiring Data



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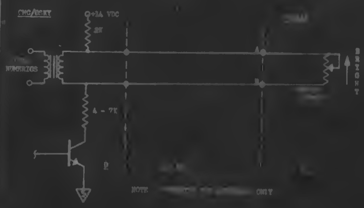
10.2 [illegible]rcuit and [illegible]ignal Characteristics



A Measurements Made from A [illegible] B, [illegible]ference

[illegible]veform: 800 [illegible] Square Wave, [illegible] maximum

[illegible] [illegible] Maximum

[illegible]

[illegible] 5%

[illegible] - [illegible]

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REVISIONS [illegible]

10.2 Circuit and Signal Characteristics (Continued)

NOTE: SCHEMATIC FOR REFERENCE ONLY

All Measurements Made from A to B, B Reference

Voltage: 115V ± 4.3 (Controlled 0 - 115 VAC)

Current: 317.5 MA @ 75V (APPROXIMATE)

Frequency: 400 cps ± 7 cps

VA: 23.8

Watts: 10.66 MAX.

P.F.: .5

Noise: Modulation: 0.5 percent

Transients: 50 to 150 volts RMS Recovery in 50 milliseconds to steady state.

Circuits: Y_1

YS_1

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[illegible]

[illegible]

[illegible] Measurements made from [illegible] Reference

[illegible]: [illegible] + 4.[illegible] [illegible]

[illegible]: [illegible]5 MA @ 75V (APPROXIMATE)

Frequency: 400 cps [illegible] cps

VA: [illegible]

Watts: [illegible].66 MAX.

[illegible]

[illegible]: Modulation: 0.5 percent

Transients: 50 to 150 volts RMS Recovery [illegible] 50 milliseconds to Steady State.

[illegible]

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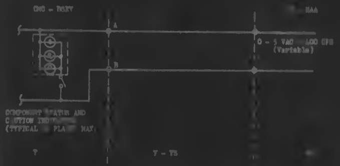
10.2 Circuit and Signal Characteristics (Cont.)



NOTE: SCHEMATIC SHOWN FOR REFERENCE ONLY

All Measurements made From A to B, B Reference

Voltage: 5 V[illegible] Variable to Off

Current: [illegible] 180 amps/display (caution indicators)
225 amps/display (status indicators)
([illegible]5 amps max drain on S/C System-for lamp test only)

Operational Current: [illegible]20 MA (approximate)

Circuits:

$Y_{[illegible]}$ and Y_4, Y_5 — As Shown Above
YS_3 and YS_4

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11.0 Computer to Computer Displays

This section describes the interface between the Computer and Main Display Panel DSKY. The interfaces consist of [illegible] lines which carry signals from the DSKY to the Computer.

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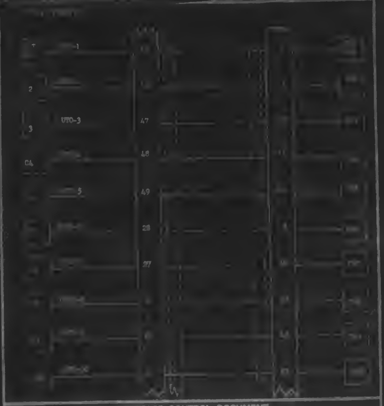

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11.1 (Cont.)

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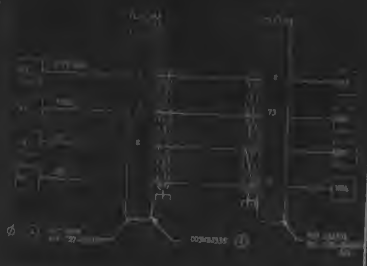

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SHEET

REVISIONS

Ø

[illegible] Amp.	[illegible]
[illegible]	[illegible] sec
[illegible] Amp	[illegible] MA Maximum
[illegible] Time	< µ sec.
Frequency	[illegible] Maximum
[illegible] Amp.	0 - 28
[illegible] Time	< µ sec.
Current Amp.	[illegible] MA Maximum
[illegible] Time	< µ sec.
[illegible]	Ground
[illegible]	[illegible]
[illegible] Current	[illegible]00 MA or Less
[illegible] Current	500 MA (pulsating)

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12.0 CMC MDC BSKY to Spacecraft Displays

This interface covers the signals from the CMC which illuminate the caution and warning lights in the "Caution and Warning" subsystem.

There shall be three signals:

1. CMC (Warning) - Indicates a malfunction in the CMC Power Supply or CMC Circuit
2. ISS (Warning) Inertial Subsystem - Indicates a malfunction in the IMU, PIPA Loop, CDU.
3. PGNS (Caution) Primary Navigation/Guidance System - Indicates Gimbal Lock, IMU Temp out of Tolerance, Radar Failure, Program Alarm, Restart (computer).

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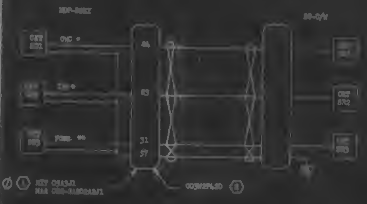
12.1 Interface Wiring Data



* Red Light
** Yellow Light

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12.2 Circuit and Signal Characteristics

All measurements made from A to B, B Ref.

Voltage: 28 VDC (nominal from S/C bus)

Current: 120 ma Steady State
1 amp peak for 10 milliseconds

Contact Rating: 0.5 amps (+28 VDC into lamp load)

<u>Circuits</u>

SRL - SR3 as shown above

SRL - SR3

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13.0 Computer to Spacecraft Power

This interface covers the Power interface to the AGC and is included in this ICD for reference only. The Power Interface for the GSE and C shall be covered in ICD MH01-01387-216.

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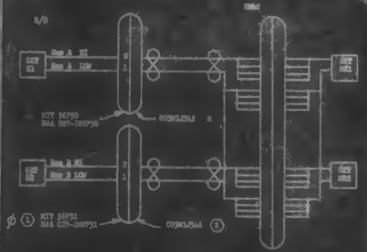
13.1 Interface Wiring Data



NOTE: For Reference Only

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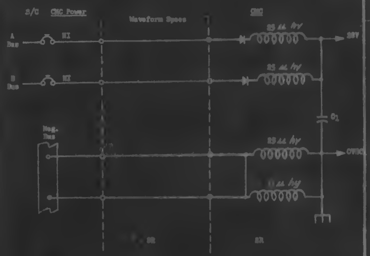
13.2 Interface Circuit and Signal Characteristics



Measurements at CMC Interface

Steady State Voltage: 25.8 to 30.8 at CMC Interface
Variations to S.S.: Per MH01-01387-216
Current: 4.24 amps maximum

<u>Circuits</u>

S1, S2
SR1, SR2

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